

Jet Propulsion Laboratory
California Institute of Technology

How Do You Go From a Concept Idea to a NASA Selected Mission?

Formulating the Psyche Discovery Mission with JPL's Concurrent Engineering Teams

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Case Study: The Psyche Mission – Journey to a Metal World

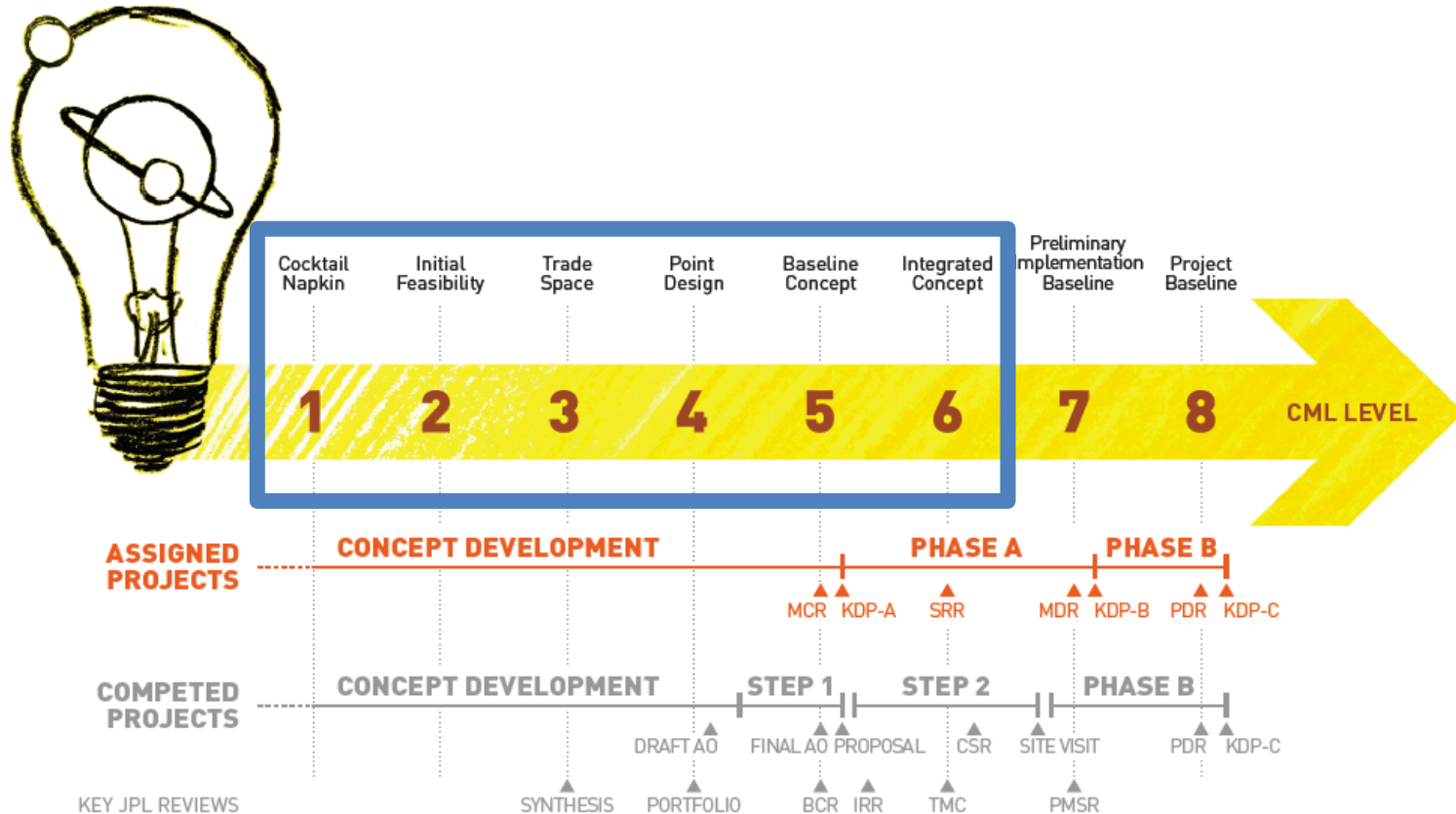


Image Credit: Peter Rubin

Competed via NASA's Discovery Program

- Largest metal asteroid, Psyche preserves a key step in the formation of terrestrial planets including Earth
- First mission to a metal world, will map features, structure, composition, and magnetic field

Concept Maturity Levels



CML 1 – The Idea

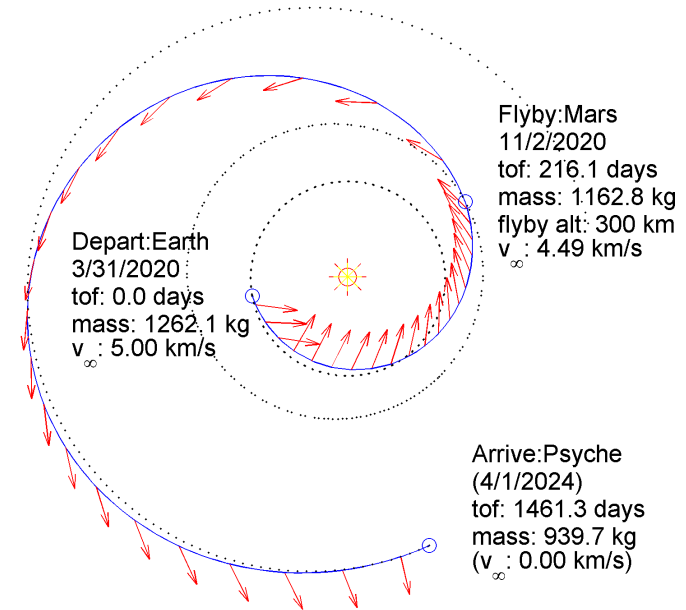


Is there a compelling Discovery Class Mission if one sent the NASA Dawn flight system to a different asteroid?

CML 2 – Initial Feasibility

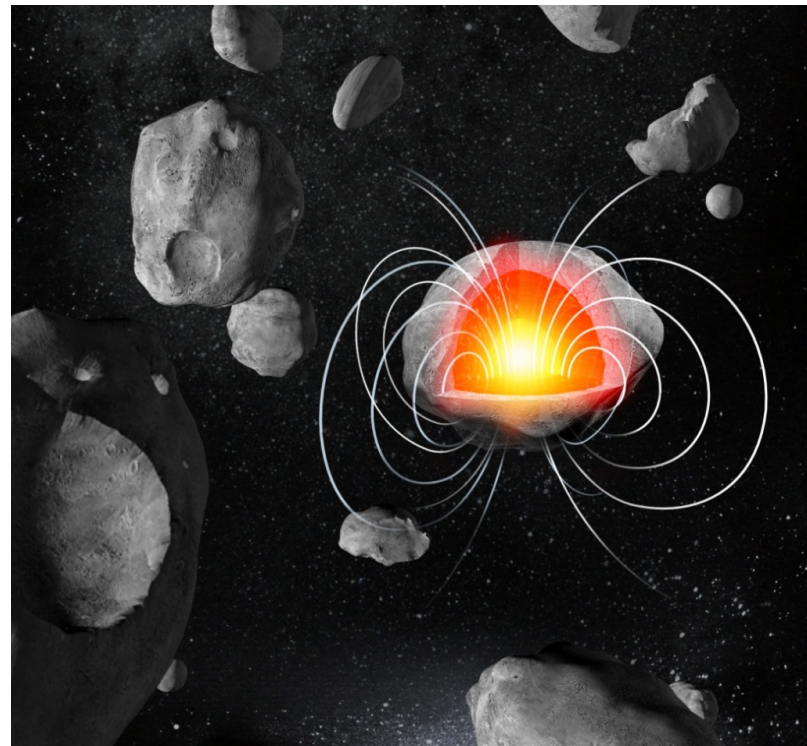
- The AO Cost Cap for a Discovery mission is \$450M in Fiscal Year 2015 dollars for phases A-D, not including the launch vehicle.
- Any selected mission will launch no later than December 31, 2021.

Planetary Missions – Feasibility starts with the Mission Design



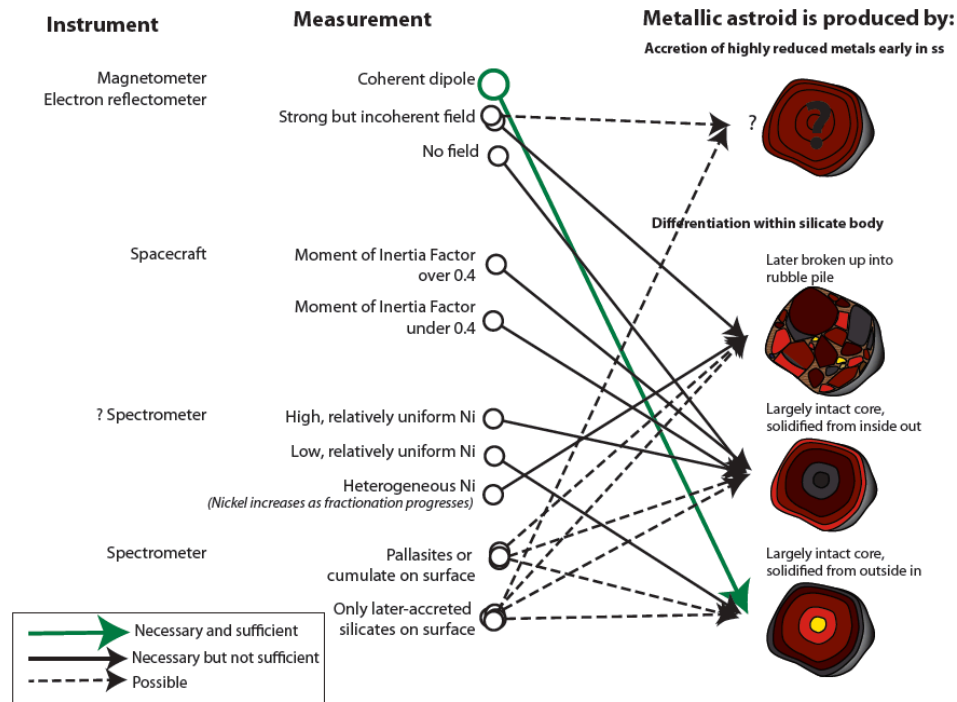
Why Psyche 16?

- Largest M-class asteroid
 - Tri-axial ellipsoid: 240 x 185 x 140 km
- Appears to be exposed core of larger differentiated body
- Good evidence for Fe-Ni composition
 - High mass density
 - Spectra indicates 90% metal
- Relatively easy access

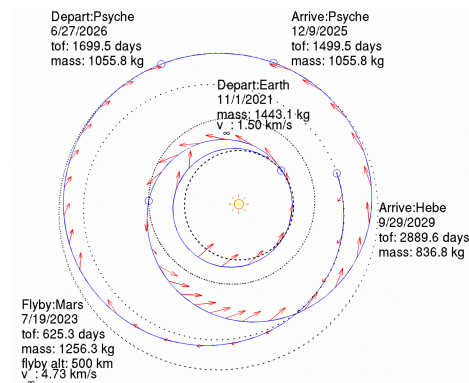
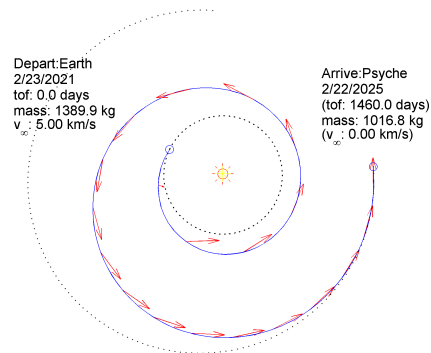
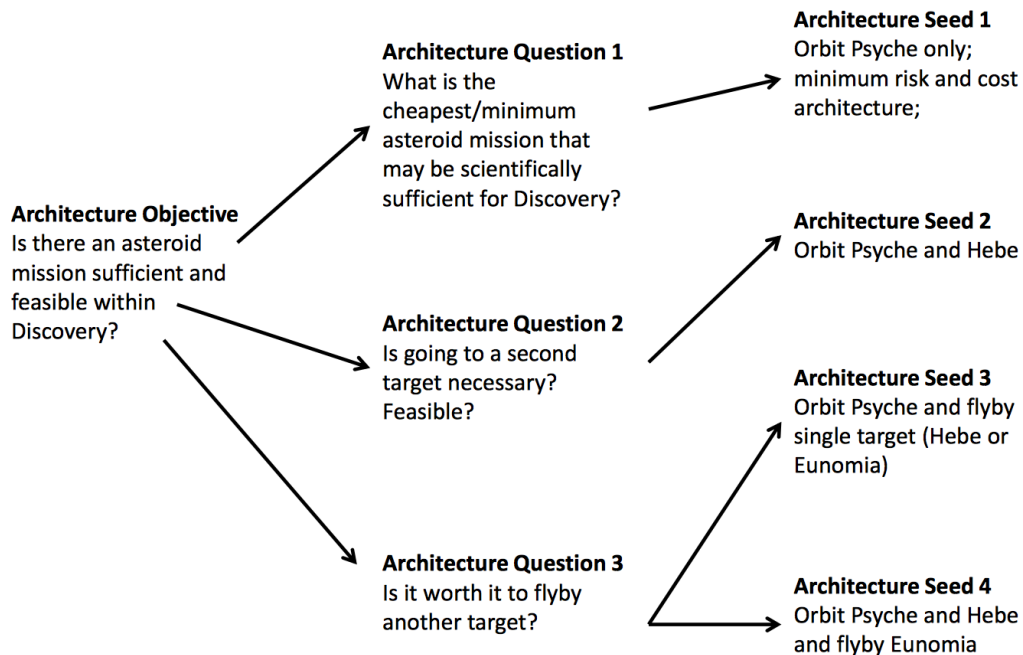


CML 3: A-Team Science Workshop

- Examine the science that drives our early concept formulation and its impact to the mission and flight system requirements
- Understand the gradient in science return vs various available mission scenarios and payload options



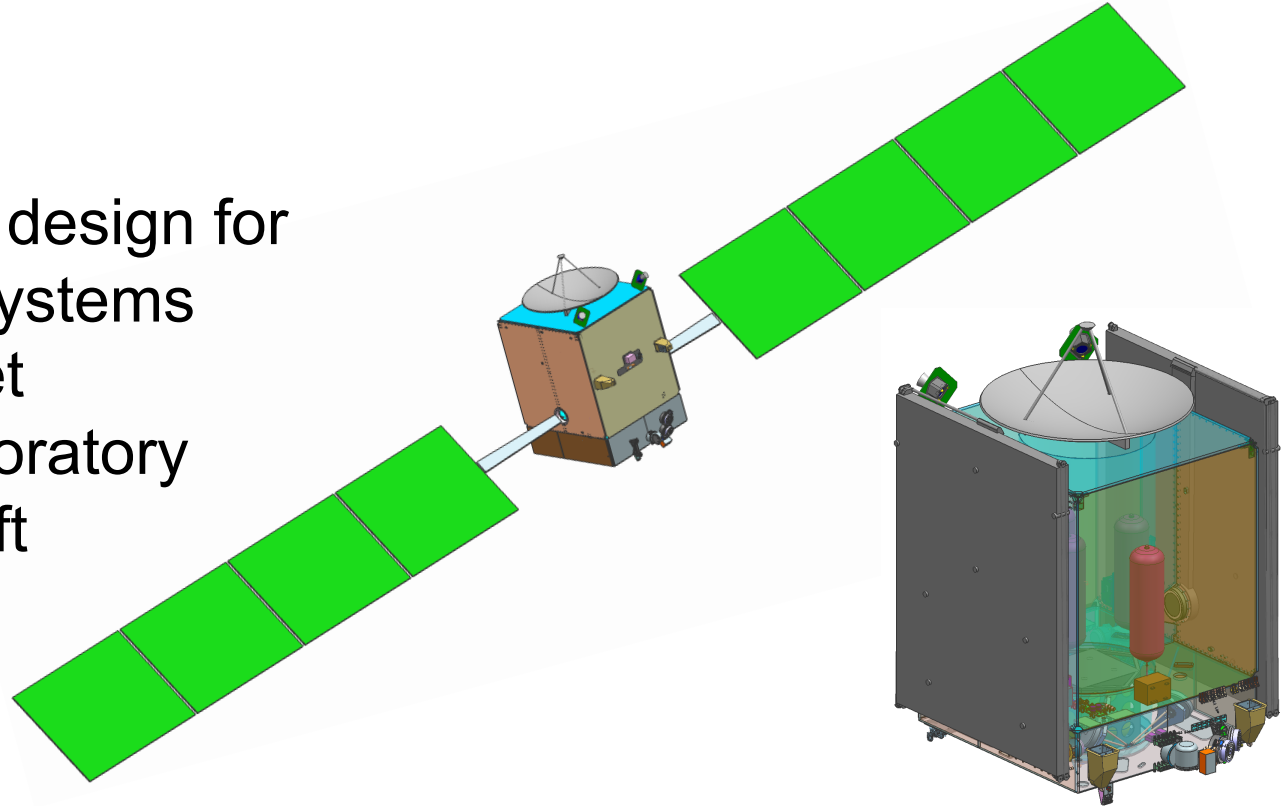
CML 3: Trade Space Exploration



CML 4: Point Design and Cost Estimate

Study Goal

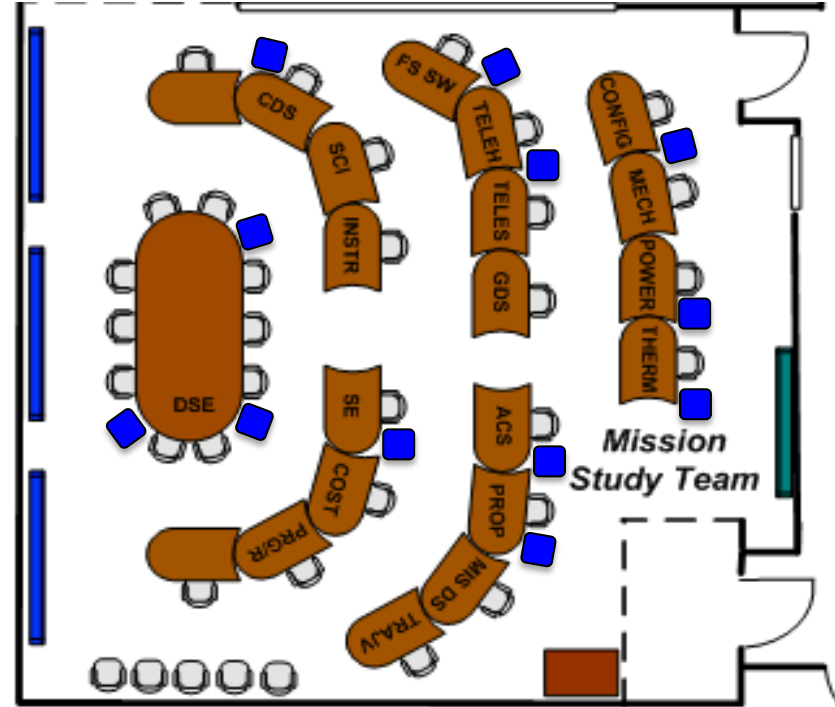
Provide a point design for
a joint Space Systems
Loral (SSL) / Jet
Propulsion Laboratory
(JPL) spacecraft



CML 4: Point Design and Cost Estimate

Study Objectives

- Design a **hybrid Space Systems Loral (SSL) / Jet Propulsion Laboratory (JPL) spacecraft development and Systems Verification, Integration and Test plan** that can support the Psyche Discovery Concept
- Estimate the **hybrid SSL/JPL cost of the (phase B/C/D) spacecraft development and the Systems Verification, Integration and Test plan** for a spacecraft that can support the Psyche Discovery Concept



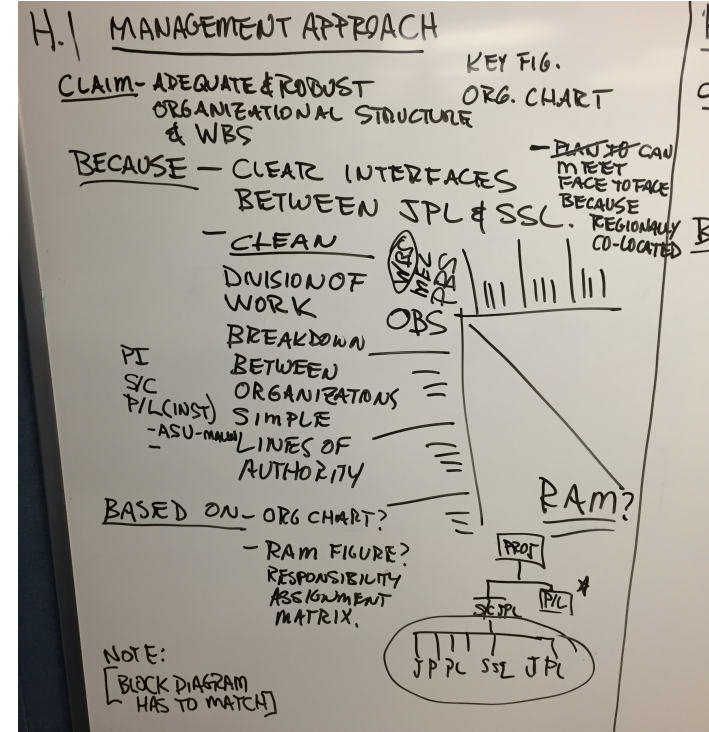
CML 5: Science, Technical, Management, & Cost Review

- Team X routinely performs mission and instrument concept reviews using concurrent and collaborative engineering techniques.
- Approach is similar to the NASA review process
 - Science panel to assess the Science Merit and Science Implementation evaluation criteria
 - Technical, Management, and Cost Review panel to assess the Mission Implementation and Cost/Risk evaluation criteria



CML 6: Strategy & Communication Development

- NASA debriefs all teams on their science and technical major/minor strengths & weaknesses
- Psyche proposal team was paired with experienced Concept/Proposal staff to work through specific communication concerns
- Outline sessions were conducted that resolved ~20 communication issues and mitigated previous Step-1 Major/minor weaknesses



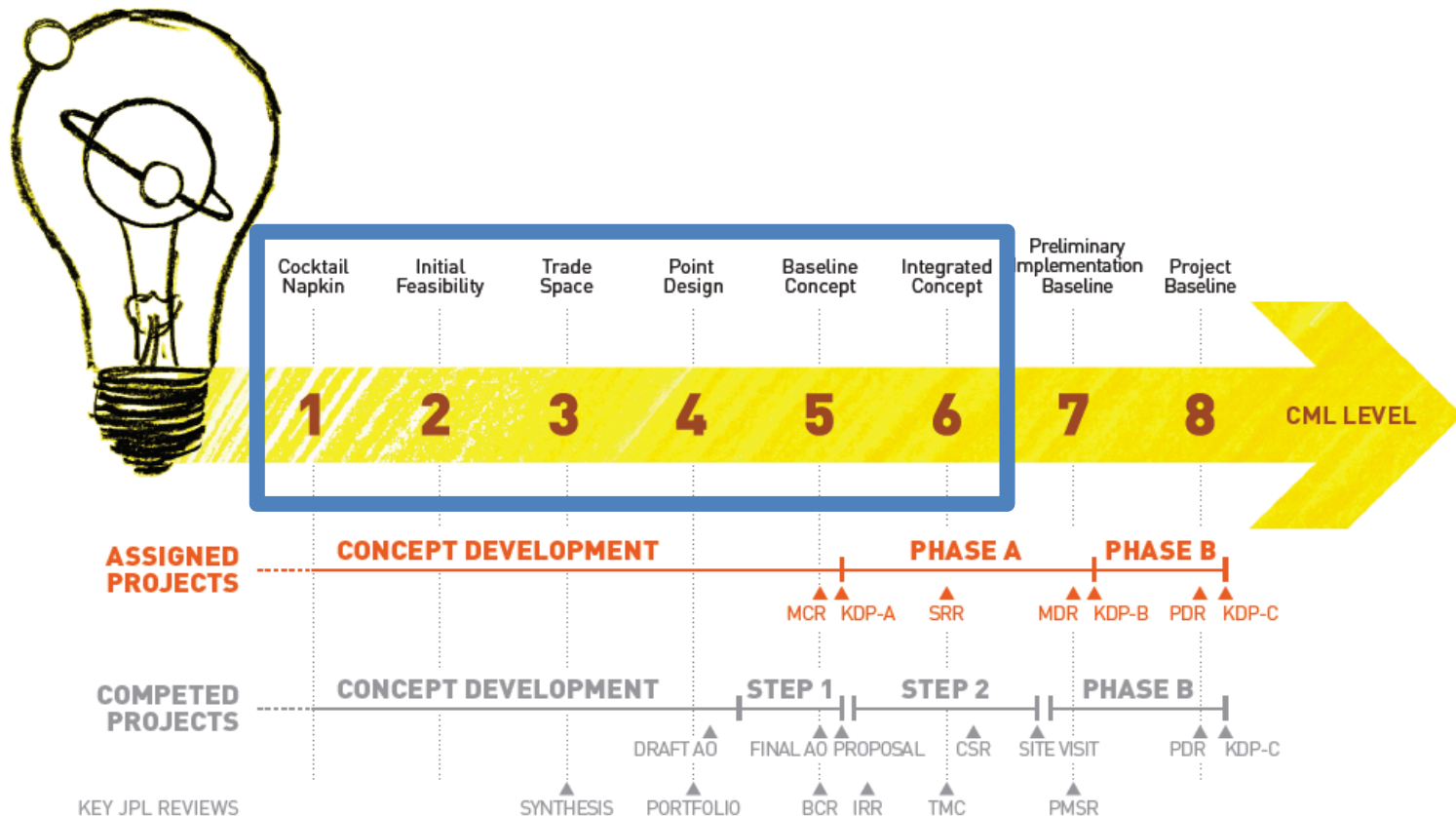
NASA Press Release – January 4, 2017



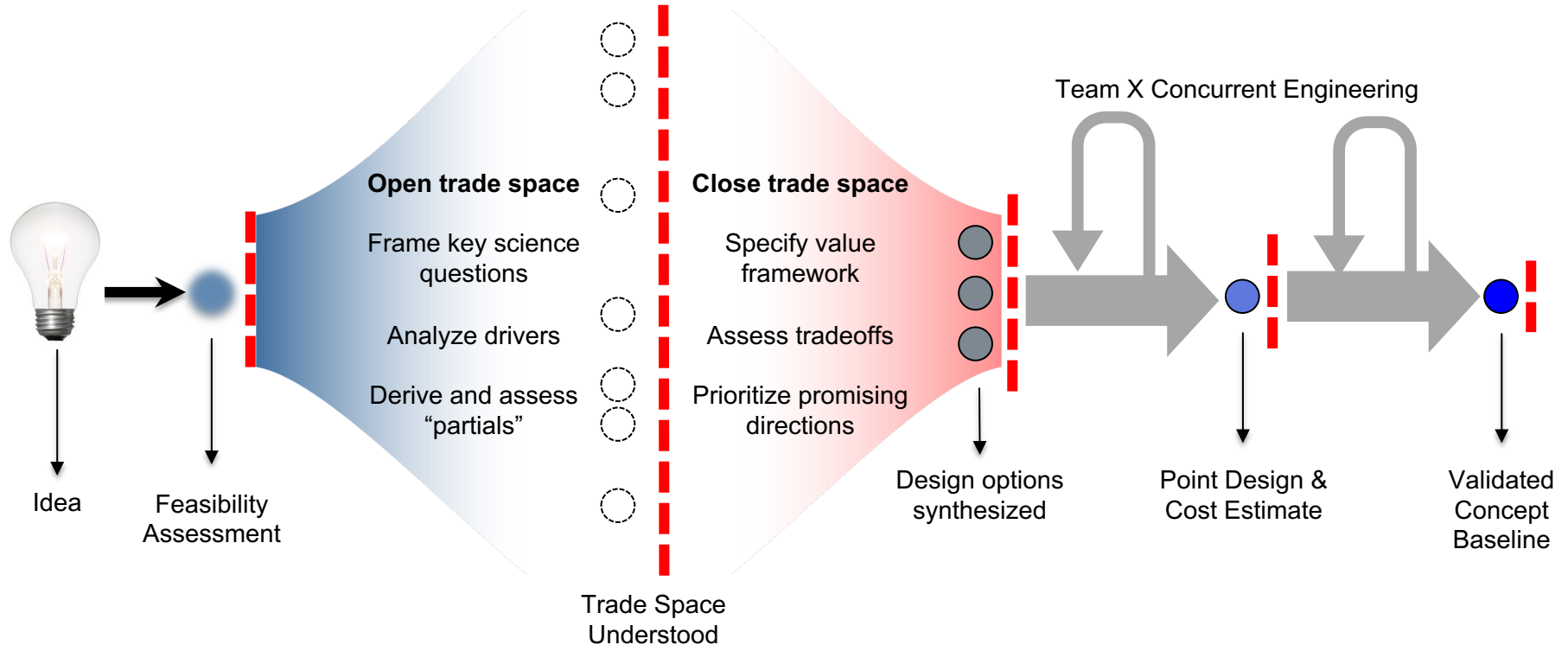
Image Credit: Peter Rubin

“Psyche, the first mission to the metal world 16 Psyche will map features, structure, composition, and magnetic field, and examine a landscape unlike anything explored before. Psyche will teach us about the hidden cores of the Earth, Mars, Mercury and Venus.”

Idea to Mission Concept

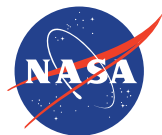


Evolution of an Idea to a Mission Concept



Acknowledgments

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- David Oh, Capture Lead and Psyche Lead Systems Engineer
- Alfred Nash, Team X Lead Engineer
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- Karen Lum and Rolf Danner, Step 1 and Step 2 Proposal Managers
- Psyche Concept Development and Proposal Team Members



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